Map and digital database of sedimentary basins and indications of petroleum in the Central Alaska Province

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EXPLANATORY NOTES

1988) and reported occurrences of petroleum in wells and natural seeps in central Alaska. The map and database were prepared for use in a U.S. Geological Survey assessment of Sedimentary basins and selected geologic features of regional importance were taken from the map of Kirschner (1988), with minor modifications in some cases. The primary source of information on seeps and older (pre-1959) wells was the report of Miller and others (1959). Additional information on seeps and wells was acquired from the published literature; public records available at the Alaska Oil and Gas Conservation Commission, the Alaska Geologic Materials Center, and the Minerals Management Service; and unpublished

This map and the accompanying digital database show sedimentary basins (Kirschner,

documents provided by companies and individuals 76 localities are depicted on the map and described in table 1. Most of the localities are within the boundary of the Central Alaska Province as defined by the 1995 National Assessment of United States Oil and Gas Resources (U.S. Geological Survey, 1995, p. 3), but the map also includes (1) 2 localities that occur north of the Central Alaska Province boundary in the uplands near Yukon Flats, and (2) several exploratory wells that were drilled west of the Central Alaska Province boundary in the offshore Norton basin. Also shown on the map are oil and gas fields in the Cook Inlet region. Not displayed on this map, but described by Miller and others (1959) and other published sources, are numerous hydrocarbon seeps and wells in southern and northern Alaska and adjacent parts of

The 76 localities depicted on this map include 3 wells with oil shows, 18 wells with gas shows, and 9 wells with no oil or gas shows. Outcrops of oil shale and (or) oil-bearing rocks have been reported at 14 localities. The 76 localities also include 29 accounts of oil seeps and 3 accounts of gas seeps; of these, investigations by the U.S. Geological Survey confirmed the existence of 1 gas seep and concluded that reports of 16 oil seeps and 1 gas

seep are doubtful or disproved. The remaining reports of 13 oil seeps and 1 gas seep are neither confirmed nor refuted and require additional study Seeps of oil and gas are among the most useful indicators of the possible existence of nearby, buried accumulations of petroleum. However, not all reports of oil and gas seeps are reliable. In many cases, people have mistaken iron stains, mineral salts (including iron oxide scums), coal tar, and living organic material for oil seeps (Miller and others, 1959; Martin, 1923). Some of the reported seeps may be practical jokes or deliberate deceptions. Also, many oil and gas seeps are ephemeral, and a seep that was observed and reported years ago may be inactive today.

No commercial petroleum production has been obtained from central Alaska, in contrast to the prolific deposits of oil and gas that have been found and commercially developed in northern Alaska and the Cook Inlet region. Nevertheless, confirmed indications of petroleum in central Alaska include (1) oil and gas in seeps and wells in the Norton basin; (2) oil shale and numerous occurrences of bitumen in Precambrian to Mesozoic rocks in the Kandik area and the uplands near the Yukon Flats basin; (3) gas in Miocene coal-bearing strata in a core hole at Fort Yukon in the Yukon Flats basin; (4) gas in wells that penetrate Tertiary coal-bearing strata in the Nenana basin; (5) gas in water wells and test holes in the Fairbanks area; (6) gas in exploratory wells, seismic shot holes, and a water well in the Kotzebue basin; (7) gas in Quaternary deposits in shallow wells in the Northway lowlands; and (8) gas in an exploratory well in the Bethel basin. The scattered distribution of confirmed oil and gas occurrences implies that active and (or) formerly active petroleum systems are present in some parts of central Alaska

most notably in certain Tertiary sedimentary basins. However, much remains to be

learned about the geology, organic geochemistry and petroleum resource potential of these

-O- Well with no oil or gas shows Oil seep, confirmed Oil seep, reported but unconfirmed Oil seep, reported but doubtful or disproved

Gas seep, confirmed

Gas seep, reported but unconfirmed Sas seep, reported but doubtful or disproved ▲ Outcrop of oil shale or oil-bearing rock

Oil field Gas field

EXPLANATION

• Well with oil show(s)

₩ell with gas show(s)

g Glacier Bouguer gravity low, in milligals. Hatched in direction of lowest gravity value

Boundary of Central Alaska Province

Bouguer gravity high

Lithologic contact

Sedimentary basin isopach; contours in kilometers. O City, town or village

Faults - dashed where approximately located Fault, throw not defined

Thrust fault, sawteeth on upper plate Late Tertiary and Quaternary basins, stippled where Thrust fault (inferred) present in outcrop Strike-slip fault - arrows indicate direction of relative Lower Tertiary in remnants of older basins. Moderately horizontal movement to strongly deformed. Locally metamorphosed. Stip-

Normal fault (inferred) Folds - dashed where approximately located

Normal fault- bar and ball on downdropped side

Anticlinorium Synclinorium

Volcanic rock cover Precambrian, Paleozoic, and Mesozoic rocks of Cordilleran fold and thrust belt Axial trace of complexly folded rocks (diagrammatic) Basement rocks - Metamorphic, igneous terranes of all

Table 1. Localities shown on map.

Feature Description and source(s) of information

Kotzebue basin and vicinity—

Oil seep, A reported oil seep on the Noatak River was investigated by the U.S. Geological Survey reported but and is regarded as "very doubtful" (Miller and others, 1959, p. 81).

Well with gas A hole drilled in 1949-1950 at Kotzebue to test for fresh water at depth found gas under high pressure in Quaternary deposits at 238 ft (73 m). The gas lifted the heavy string of drilling tools several feet into the air, showered the area with mud, and continued to flow at decreasing pressure for more than 24 hours. The well reportedly penetrated gravel to a depth of 23 ft (7 m), blue mud to a depth of 79 ft (24 m), thawed gravel containing salt water at 79-83 ft (24-25 m), frozen blue clay or mud containing sand and gravel at 83-238 ft (25-73 m), and thawed brown silt saturated with salt water from 238 ft (73 m) to the bottom of the hole at 325 ft (99 m) (Cederstrom, 1952, p. 35; Miller and others, 1959, p. 81). The gas is thought to have been derived from

decaying vegetal material in the Quaternary deposits (Miller and others, 1959, p.

bitumen suggest that it is biodegraded, thermally immature, and probably derived

carbon isotopic compositions of hydrocarbons in the latter two samples indicated

3 Well with gas The Standard Oil Company of California Nimiuk Point Well No. 1 was drilled in 1974 to a total depth of 6,311 ft (1,924 m) and abandoned as a dry hole. The mudlog depicts small amounts of methane at about 400-600 ft (120-180 m) and trace amounts of methane at 750 ft (230 m) and possibly at 3,900 ft (1,190 m). The mudlog also shows a trace of tar contamination at about 750 ft, but the source of the contamination is unclear. A formation test of the interval 3,537-3,755 ft (1,078-1,145 m) recovered salt water but no oil or gas. Rock-Eval pyrolysis of ditch samples at depths of 790 ft (241 m) and 1,420 ft (433 m) found evidence of bitumen in the form of coalescing S1 and S2 peaks; organic geochemical analyses (including chromatograms) of this

from terrigenous organic material. Well with gas Gas was found at a depth of 90 ft (27 m) in a seismic shot hole drilled in 1973 by the show(s) Standard Oil Company of California on the Kobuk River Delta, about 33 miles (53 km) southeast of Kotzebue. Laboratory analysis of the gas showed it to consist of about 66 percent methane, 26 percent nitrogen, 6 percent oxygen, 2 percent carbon dioxide, and trace amounts of ethane and higher alkanes. Two additional samples of gas were obtained from another shot hole of uncertain location but presumably nearby, and were found to consist of 96-97 percent methane, 1-2 percent nitrogen, 1-2 percent carbon dioxide, and trace amounts of ethane and higher alkanes. Analyses of the

Well with gas Gas was found at a depth of 65 ft (20 m) in a seismic shot hole drilled in 1973 by show(s) the Standard Oil Company of California on the Kobuk River Delta, about 40 miles (64 km) southeast of Kotzebue. Laboratory analysis of the gas showed it to consist of about 64 percent methane (presumably of biogenic origin), 19 percent nitrogen, 17 percent carbon dioxide, less than 1 percent oxygen, and trace amounts of ethane and

that the methane was of biogenic origin.

6 Well with gas The Standard Oil Company of California Cape Espenberg Well No. 1 was drilled in show(s) 1975 to a total depth of 8,373 ft (2,552 m) and abandoned as a dry hole. No shows of oil or gas were reported in the well history, but the mudlog depicts small amounts of methane associated with coal-bearing strata. Formation tests of four intervals recovered some salt water but no oil or gas. Rock-Eval pyrolysis of ditch samples at depths of 1,450 ft (442 m) and 2,290 ft (698 m) found evidence of bitumen in the form of coalescing S1 and S2 peaks; organic geochemical analyses (including chromatograms) of this bitumen suggest that it is biodegraded, thermally immature,

and probably derived from terrigenous organic material.

7 Oil seep, A reported oil seep located about 15 miles (25 km) southeast of Devil Mountain in reported but the northern coastal plain of the Seward Peninsula is said to be marked by "a spring doubtful or that never freezes and leaves a red stain, tasting like gasoline in the snow" (Miller and disproved others, 1959, p. 81-82). This occurrence was later investigated by a bush pilot who reported a pond covered with slush ice in which there were 5 holes from which water was issuing, one of which smelled strongly of gasoline or crude oil. D.M. Hopkins, a geologist of the U.S. Geological Survey, flew over the site in 1949 and later stated that he believed it to be a warm spring and that any gases present were marsh gases from decaying peat, but that it was conceivable that it could be an oil seep (Miller and

others, 1959, p. 81-82).

8 Oil seep, A reported oil seep in the headwaters area of the Nugnugaluktuk River, about 10-15 reported but miles (15-25 km) south of Devil Mountain in the northern coastal plain of the Seward unconfirmed Peninsula, is said to have been marked by an oil slick on a small lake, but has not been investigated by the U.S. Geological Survey (Miller and others, 1959, p. 81). A sample reportedly collected from the seep yielded gasoline upon distillation and therefore was undoubtedly a mineral oil, according to a laboratory report dated 1922

and cited by Miller and others (1959, p. 81). Norton basin and vicinity—

9 Oil seep, Oil seeps have been reported in the Sinuk Valley near the junction of the Sinuk reported but and Stewart Rivers about 20 miles (32 km) northeast of Nome, but have not been unconfirmed investigated by the U.S. Geological Survey (Miller and others, 1959, p. 80, plate 1). The Bartholomae Oil Company reportedly drilled several exploratory wells in the area but the locations and dates of these wells are uncertain (Miller and others, 1959, p.

Oil seep, Oil seeps have been reported from the coastal plain near Nome but their existence is reported but regarded as doubtful (Miller and others, 1959, p. 80, plate 1). doubtful or

Well with gas Four exploratory oil wells were drilled in the coastal plain near Nome (Cathcart, 1920, show(s) p. 196-197; Miller and others, 1959, p. 80). Two wells were drilled in 1906; the first well encountered gas at a depth of 122 (37 m) which "blew a 1,200-pound stem 75 feet up the hole," whereas the second well was 176 ft (57 m) deep and reportedly yielded a trace of oil. Two more wells were drilled in 1918; the first well was abandoned at a depth of 210 ft (64 m) owing to the loss of a bailer in the hole, and the second

well reached a depth of about 150 ft (46 m) before drilling was apparently stopped

(Cathcart, 1920, p. 196-197; Miller and others, 1959, p. 80). Gas seep, In 1976, a submarine seep of gas was discovered in Norton Sound about 25-30 miles confirmed (40-50 km) south of Nome (Cline and Holmes, 1977; Kvenvolden and Claypool, 1980). Subsequent sampling and analysis showed that the gas consisted of about 98 percent CO_2 with minor amounts of hydrocarbons consisting of gas-range (C_1 to C_4) and gasoline-range (C₅ to C₈) molecules (Kvenvolden and Claypool, 1980). The molecular and isotopic characteristics of the hydrocarbons suggest that they formed by thermal alteration of marine and (or) nonmarine organic matter buried within Norton basin, whereas the CO₂ probably formed from decarbonation of carbonate rocks by heat or

fluids (Kvenvolden and Claypool, 1980).

Number Feature Description and source(s) of information

Well with oil The ARCO OCS Y-0436 Well No. 1 in Norton Sound was drilled in 1984 on the Birch show(s) prospect to a total depth of 10,950 ft (3,338 m) and abandoned as a dry hole. The well was located about 33 miles (53 km) southwest of Nome in about 65 ft (20 m) of water. The mudlog indicates strong shows of methane at depths of 1,200-3,600 ft (366-1,097 m); sporadic, weak shows of oil at 7,800-8,400 ft (2,377-2,560 m); and numerous minor shows of gas (including methane, ethane, and higher alkanes) at many intervals below 8,400 ft (2,560 m). However, none of these shows were considered worthy of a drill stem test (Smith, 1994, p. 37).

Well with gas The COST Well No. 1 in Norton Sound was drilled in 1980 to a total depth of 14,683 show(s) ft (4,475 m) and abandoned as a dry hole. The well was located in about 90 ft (30 m) of water in the St. Lawrence subbasin, about 54 miles (87 km) southwest of Nome. Biogenic methane was reported at depths shallower than 6,000 ft (1,800 m) and traces of thermogenic hydrocarbons were found at depth, but no significant oil shows were encountered in this well (Turner and others, 1986, p. 103).

Well with gas The Exxon OCS Y-0414 Well No. 1 in Norton Sound was drilled in 1984 on the South show(s) Teton prospect to a total depth of 3,636 ft (1,108 m) and abandoned as a dry hole. The well was located about 63 miles (101 km) southeast of Nome in about 54 ft (16 m) of water. The mudlog shows moderate to strong shows of methane at about 1,200-2,100 ft (366-640 m); minor shows of methane below 2,200 ft (671 m); and a trace of oil at about 3,450-3,470 ft (1,052-1,058 m). No drill stem tests were conducted (Desautels, 1988, p. 522-524; Smith, 1994, p. 37).

Well with gas The Exxon OCS Y-0407 Well No. 1 in Norton Sound was drilled in 1985 on the Yellow show(s) Pup prospect to a total depth of 7,867 ft (2,398 m) and abandoned as a dry hole. The well was located about 62 miles (99 km) southeast of Nome in about 55 ft (17 m) of water. The mudlog depicts moderate to strong shows of methane at about 2,100-3,100 ft (640-945 m) and sporadic, weak to moderate shows of gas associated with coal-bearing intervals at about 3,200-3,300 ft (975-1,006 m), 5,250-5,850 ft (1,600-1,783 m), and 7,150-7,600 ft (2,179-2,316 m). Some of the gas is thought to be of thermogenic origin, but no oil shows were encountered (Desautels, 1988, p. 527) and no drill stem tests were conducted (Smith, 1994, p. 37).

Well with gas The Exxon OCS Y-0398 Well No. 1 in Norton Sound was drilled in 1985 on the show(s) Cascade prospect to a total depth of 6,913 ft (2,107 m) and abandoned as a dry hole. The well was located about 62 miles (99 km) southeast of Nome in about 55 ft (17 m) of water. The mudlog depicts numerous small indications of methane throughout the well, and many of the methane shows at 2,800-5,400 ft (853-1,646) appear to be associated with coal-bearing intervals. Minor fluorescence was noted on the mudlog at 4,930-4,940 ft (1,503-1,506 m) and 5,370-5,430 ft (1,637-1,655 m), but no oil shows were encountered and no drill stem tests were conducted (Desautels, 1988, p. 526; Smith, 1994, p. 37).

Well with oil The COST Well No. 2 in Norton Sound was drilled in 1982 to a total depth of 14,889 show(s) ft (4,538 m) and abandoned as a dry hole. The well was located in about 49 ft (15 m) of water in the Stuart subbasin, about 68 miles (110 km) southeast of Nome. Biogenic gas was found in near-surface sandstones, and minor shows of gas, oil, and solid bitumen were reported from Eocene strata below depths of about 10,000 ft (3,000 m) (Turner and others, 1986, p. 117, p. 121). Oil from a show at 12,240 ft (3,731 m) is paraffinic and thought to have been generated from nearby nonmarine source rocks (Desautels, 1988, p. 518-519). A strong show of gas was encountered in sandstone at about 12,210 ft (3,722 m) (Smith, 1994, p. 43).

Well with gas The Exxon OCS Y-0425 Well No. 1 in Norton Sound was drilled in 1985 on the flank show(s) of the Chugach prospect to a total depth of 6,093 ft (1,857 m) and abandoned as a dry hole. The well was located about 78 miles (124 km) southeast of Nome in about 40 ft (12 m) of water. The mudlog depicts no indications of oil but evinces moderate to strong shows of methane at depths of about 1,200-3,000 ft (366-914 m) and minor shows of gas (including methane, ethane, and higher alkanes) in a coal-bearing interval at about 4,900-5,550 ft (1,494-1,692 m). No drill stem tests were conducted (Desautels, 1988, p. 527; Smith, 1994, p. 37 and p. 39).

Well with oil The Exxon OCS Y-0430 Well No. 1 in Norton Sound was drilled in 1984 on the show(s) Chugach prospect to a total depth of 4,951 ft (1,509 m) and abandoned as a dry hole. The well was located about 83 miles (132 km) southeast of Nome in about 35 ft (11 m) of water. The mudlog exhibits numerous small to moderate shows of methane at depths of about 1,200-4,000 ft (365-1220 m) and sporadic, minor shows of methane and higher alkanes below 4,100 ft. No indications of oil are shown on the mudlog, but a subsequent report by Desautels (1988, p. 522) states that small amounts of free oil containing about 2 percent sulfur were found while coring Paleozoic(?) schist below 4,800 ft (m). The source of this high-sulfur oil is unknown but may have been carbonate rocks within the Paleozoic(?) interval. No drill stem tests were conducted (Desautels, 1988, p. 522-525).

Oil seep, An oil seep reportedly occurs along the Inglutalik River, which drains into Norton reported but Bay, but has not been investigated by the U.S. Geological Survey (Miller and others,

Outcrop of Oil shale reportedly occurs on Besboro Island in Norton Sound (Miller and others, oil shale or 1959, p. 80). A 1958 U.S. Geological Survey field investigation, however, found no oil-bearing oil shale and determined that Besboro Island consists mostly or entirely of altered volcanic and volcaniclastic rocks correlative with those of the Koyukuk terrane (W.H. Patton, oral commun., 2002). The reported occurrence of oil shale is herein regarded as doubtful because it is in an unfavorable geologic setting.

Yukon-Koyukuk flysch belt of Kirschner (1988) —

Innoko basin and vicinity—

Well with no The P.G. Benedum Nulato Unit Well No. 1 was drilled in 1960 to a total depth of oil or gas 12,015 ft (3,662 m) and abandoned as a dry hole. No shows of oil or gas were reported and no drill stem tests were conducted.

Oil seep, A reported oil seep along the Innoko River about 85 miles (135 km) northeast of Aniak reported but is regarded as doubtful on the basis of field investigations by the U.S. Geological doubtful or Survey (Miller and others, 1959, plate 1).

Oil seep, A reported oil seep along the Yukon River about 40 miles (65 km) northeast of Aniak reported but is regarded as doubtful on the basis of field investigations by the U.S. Geological doubtful or Survey (Miller and others, 1959, plate 1).

Oil seep, A reported oil seep on the northwest side of the Innoko River, about 30 miles (50 km) reported but northeast of Anvik, has not been investigated by the U.S. Geological Survey (Miller unconfirmed and others, 1959, plate 1).

Number Feature Description and source(s) of information

reported but northeast of Anvik, has not been investigated by the U.S. Geological Survey (Miller unconfirmed and others, 1959, plate 1). Gas seep, A reported gas seep, located along the Yukon River about 20 miles (30 km) north reported but of Anvik, is regarded as doubtful on the basis of field investigations by the U.S. doubtful or Geological Survey (Miller and others, 1959, plate 1).

Gas seep Pockets of gas reportedly collect beneath the ice of the Yukon River at Anvik. During

underlying alluvial deposits (Miller and others, 1959, p. 70).

reported but the winter, children break the ice and ignite the gas, which burns for periods as long

unconfirmed as a minute. The gas is thought to be derived from decaying vegetal material in the

Oil seep, A reported oil seep on the southeast side of the Innoko River, about 30 miles (50 km)

Bethel basin and vicinity-

Oil seep, A reported oil seep, located about 30 miles (50 km) southwest of Anvik along the reported but Stuyahok River, is regarded as doubtful on the basis of field investigations by the doubtful or U.S. Geological Survey (Miller and others, 1959, plate 1).

Oil seep, A reported oil seep along the Yukon River near the village of Paimiut, about 45 miles reported but (70 km) south of Anvik, has not been investigated by the U.S. Geological Survey unconfirmed (Miller and others, 1959, plate 1). Oil seep, A reported oil seep along the Yukon River near Toklik (formerly called Bennetts), reported but about 60 miles (95 km) north of Bethel, is regarded as doubtful on the basis of field

doubtful or investigations by the U.S. Geological Survey (Miller and others, 1959, plate 1, p. disproved 79). Oil seep, A reported oil seep near Whitefish Lake, south of the Kuskokwim River, has not been reported but investigated by the U.S. Geological Survey (Miller and others, 1959, p. 79).

reported but not been investigated by the U.S. Geological Survey (Miller and others, 1959, p. 79). Outcrop of Friable sandstone with an oil odor and causing a smudge on the hands has been oil shale or reported on the north side of Nelson Island but has not been investigated by the U.S. oil-bearing Geological Survey. The sandstone is associated with coal beds and thought to be of Cretaceous age (Miller and others, 1959, p. 79; Coonrad, 1957; Waskey, 1946, p.

Oil seep, A second reported oil seep near Whitefish Lake, south of the Kuskokwim River, has

Well with gas The Pan American Petroleum Corp. Napatuk Creek Well No. 1 was drilled in 1961 to show(s) a total depth of 14,910 ft (4,545 m) and abandoned as a dry hole. A small amount of gas associated with coal was observed in a core from Cretaceous rocks at depths of 3,121-3,141 ft (951-957 m). No mudlog was made during drilling of this well (Mull and others, 1995), but a subsequent analysis of drill cuttings found weak and questionable shows of oil in Cretaceous rocks at depths of 2,720 ft, 7,220 ft, and 10,180 ft (829 m, 2,201 m, and 3,103 m, respectively). Four drill stem tests were conducted but no shows of oil or gas were found.

Well with no The Pan American Petroleum Corp. Napatuk Creek Core Hole No. 2 was drilled in oil or gas 1960 to a total depth of 1,423 ft (434 m) and abandoned as a dry hole. No shows of oil or gas were reported, and no drill stem tests were conducted. Well with no The Pan American Petroleum Corp. Napatuk Creek Core Hole No. 2A was drilled in oil or gas 1960 to a total depth of 2,140 ft (652 m) and abandoned as a dry hole. No shows of

shows oil or gas were reported, and no drill stem tests were conducted. Well with no The Pan American Petroleum Corp. Johnston River Core Hole No. 1 was drilled to a oil or gas total depth of 1,205 ft (367 m) in 1963 and abandoned as a dry hole. No shows of oil or gas were reported, and no drill stem tests were conducted. Well with no A water well drilled in 1952 at the Alaska Native Service Hospital in Bethel penetrated

oil or gas unconsolidated deposits to a depth of 450 ft (137 m) and hard drilling, possibly in sandstone, to the well's total depth at 454 ft (138 m). Permafrost was present to a depth of 403 ft (123 m). No shows of hydrocarbons were encountered (Miller and others, 1959, p. 78).

reported but they have seen oil in this area, but these reports have not been investigated by the

unconfirmed U.S. Geological Survey (Miller and others, 1959, p. 79). Bristol Bay basin and vicinity— Oil seep, A reported oil seep near Togiak is regarded as doubtful because it is in an unfavorable

reported but geologic setting (Miller and others, 1959, plate 1).

41 Oil seep, An oil seep near the Eek River is said to have been seen from the air, and natives say

disproved Kuskokwim flysch belt of Kirschner (1988) –

Outcrop of Cinnabar at the Mountain Top mercury deposit, about 40 miles (65 km) southeast oil shale or of Sleetmute, is accompanied by "small quantities of a light- to dark-brown liquid oil-bearing and solid hydrocarbon * * *. Most of the hydrocarbon is found as a transparent, light-brown liquid filling vugs and fractures within chalcedony veinlets. Many of the chalcedony veinlets contain close packed shells of quartz and chalcedony, some of which contain solid dark-brown to black hydrocarbons" (Sorg and Estlund, 1972). The cinnabar occurs where faults cut olivine basalt that, in turn, intrudes shale and graywacke of the Cretaceous Kuskokwim Group (Sorg and Estlund, 1972).

Kobuk flysch belt of Kirschner (1988) –

Oil seep, Reports of three oil seeps near Allakaket on the Koyukuk River are regarded as reported but doubtful because the reports were based on observations "made by a prospector doubtful or many years ago, and seeps have not been seen by, or reported to, geologists who have disproved recently been in Allakaket" (Miller and others, 1959, p. 72). Nenana basin and vicinity—

Well with gas The Union Oil Co. of California Nenana Well No. 1 was drilled in 1962 to a total show(s) depth of 3,062 ft (933 m) and abandoned as a dry hole. The mudlog indicates minor amounts of gas associated with coal-bearing strata below about 2,050 ft (625 m). No drill stem tests were conducted, and there were no reported shows of oil.

Feature Description and source(s) of information

Well with gas The ARCO Totek Hills Well No. 1 was drilled in 1984 to a total depth of 3,590 ft (1,094 show(s) m) and abandoned as a dry hole. The mudlog depicts numerous indications of gas, many of which appear to be associated with coal-bearing intervals, but no indications Oil seep, Oil seeps reportedly located near the mouth of the Nenana River are considered to be

reported but doubtful (Miller and others, 1959, p. 86, plate 1). Oil seep, An oil seep along Totatlanika River (formerly Totatlanika Creek) was reportedly reported but observed during the early 1920's, and a hole that did not strike oil was drilled to a doubtful or depth of 40 ft (12 m) where it bottomed in sandstone. A sample of oily sand and gravel

Thickness of Cenozoic basin fill

pled where present in outcrop

basins of interior Alaska

1 to 3 km

3 to 5 km

Greater than 5 km

Less than 1 km - zero line not identified on continental

Fold belts of the Colville foredeep, Eagle basin, Alaska

Pervasively deformed and metamorphosed flysch belts

Complexly deformed and locally metamorphosed flysch

Peninsula, Cook Inlet and Copper River basins

is consistent with kerosene, which may have been accidentally spilled or otherwise introduced into the sample. Oil seep, A reported oil seep along California Creek, about 12-13 miles (19-21 km) east of Ferry, reported but is regarded as doubtful on the basis of field investigations by the U.S. Geological doubtful or Survey (Miller and others, 1959, plate 1).

disproved from the seep was submitted to a chemist and yielded about 5 oz of oil consisting of

88.5 weight percent "illuminating oil" (Miller and others (1959, p. 86). This analysis

Oil seep, A reported oil seep in the Nenana coal field along Healy Creek, about 7-8 miles (11reported but 13 km) east of Healy, was the subject of detailed field and laboratory investigations doubtful or and found to be a natural coal tar produced by distillation from burning coal beds disproved (Martin, 1923, p. 137-147; Miller and others, 1959, p. 61, plate 1).

reported but of Healy is regarded as doubtful on the basis of field investigations by the U.S. doubtful or Geological Survey (Miller and others, 1959, p. 61, plate 1). Oil seep, Reports of oil-saturated tundra tussocks at a trail crossing along the Wood River,

reported but south of Fairbanks, but its existence is regarded as doubtful (Miller and others, 1959, doubtful or p. 86, plate 1).

Well with gas Numerous water wells and test holes in unconsolidated alluvium in the Fairbanks show(s) area have encountered marsh gas (Miller and others, 1959, p. 86). Well with no In 1965, a well near Eielson Air Force Base was drilled to a total depth of 9,774 ft

Dusel-Bacon and Murphy, 2001).

oil or gas (2,979 m) for military purposes. The well began in schist of the Yukon-Tanana Upland shows and remained entirely in schist and amphibolite to total depth (Bunker and others,

Outcrop of Small amounts of oil shale occur as chips and slabs in soil and float on a hill east of oil shale or the Christian River, about 27 miles (43 km) north of Christian Village. Samples of the oil-bearing oil shale yielded 60-144 gallons of oil per ton of rock; the oil was described as green and sedimentary rocks of the Tozitna terrane (Brosgé and Reiser, 2000).

Oil seep, The location of an oil seep along the Christian River is variously reported as either (a) reported but about 4 miles (6 km) east of Brown Grass Lake at the junction of the Christian River unconfirmed and a large, unnamed, south-southeast-flowing creek (F.R. Weber, W.P. Brosgé, and terrane from Devonian sedimentary rocks (Brosgé and others, 2000).

Outcrop of In an area west of the Christian River about 17 miles (27 km) northwest of Christian rocks (Hawley and Garcia, 1976; Brosgé and Reiser, 2000, p. 6).

Well with gas In 1994, the U.S. Geological Survey drilled a stratigraphic core hole at Fort Yukon to show(s) a total depth of 1,281 ft (390 m). Gas, of unknown composition but widely presumed to be methane, was observed bubbling from cores taken from lignite-bearing middle Miocene strata in the bottom 22-28 ft (7-9 m) of the hole (Ager, 1994; T.A. Ager, written commun., 2000). Nearby, Fort Yukon Water Well No. 2 was drilled in 1954 by the U.S. Army Corps of Engineers to a total depth of 440 ft (134 m) in Pleistocene or late Tertiary lacustrine(?) silt and silty sand; no indications of oil or gas were reported from this well (Williams, 1962, p. 303).

60 Oil seep, A reported oil seep along the Coleen River has not been investigated by the U.S.

reported but Geological Survey (Miller and others, 1959, plate 1). unconfirmed Oil seep, A reported oil seep along the Porcupine River near Old Rampart has not been

Oil seep, A reported oil seep in the Nenana coal field about 15-20 miles (25-30 km) northeast

reported but about 35 miles (55 km) south of Fairbanks, were investigated in 1954 by U.S. doubtful or Geological Survey geologists who found iron-oxide scum on pond surfaces but no disproved indications of oil (Miller and others, 1959, p. 86). Oil seep, An oil seep was reported near the head of Clear Creek, about 25-30 miles (40-50 km)

1973; Forbes and Weber, 1975; Turner and Forbes, 1976; Naeser and Forbes, 1976;

Yukon Flats basin and vicinity—

in color with an API gravity of 31.1-33.4 degrees (Mertie, 1929, p. 138-139; Mertie, 1930, p. 132; Ebbley, 1944; Miller and others, 1959, p. 56; Tailleur and others, 1967; Hawley and Garcia, 1976; Native Village of Venetie, 1981; Brosgé and Reiser, 2000). Pieces of the oil shale were formerly burned as campfire fuel by local people of the area formerly known as the Venetie Indian Reservation, but most of the oil shale is now gone (Ebbley, 1944; Hawley and Garcia, 1976; Brosgé and Reiser, 2000). Petrographic analysis revealed that the oil shale is tasmanite, a rock composed largely of the marine algae Tasmanites (Tailleur and others, 1967; Morgridge, 1995a, b; Brosgé and Reiser, 2000). The oil shale resembles "tough, dark, leathery wood" and is light in weight, weathering to a gray color, with polished and slickensided surfaces (Ebbley, 1944, p. 12). No in-place outcrops of the oil shale are known, despite numerous attempts to find them, including hand trenching, bulldozer excavations, and shallow auger drilling (Baggs and Blasko, 1979). Some oil industry geologists speculate that the oil shale occurs as small, isolated pods that are sparsely distributed rather than as a single, laterally persistent stratigraphic horizon (Baggs and Blasko, 1979). The oil shale is thought to be of Triassic or Permian age and is associated with igneous

I.L. Tailleur, written communs., 1960-1967), or (b) close to "the bend of the Christian River near the south endline of T32N" (Native Village of Venetie, 1981). However, neither the location nor the existence of the seep have been confirmed by field investigations (Hawley and Garcia, 1976, p. 4-2). The reported seep may have been along a fault that separates Jurassic to Mississippian volcanic rocks of the Tozitna

oil shale or village, oil shale (said to be tasmanite) was found in ground squirrel diggings near the oil-bearing head of Kocacho Creek and is associated with outcrops of chert and mafic volcanic

reported but investigated by the U.S. Geological Survey (Miller and others, 1959, plate 1).

to just above this depth.

oil shale or Formation (Van Kooten and others, 1997).

rock

Number Feature Description and source(s) of information

St. Matthew basin

BERING SEA

CHUKOTSK PENINSULA

Oil seep, An oil seep near the north bank of the Porcupine River, about 300 ft (90 m) below reported but Deacons Rock, was reportedly found during the late 1960's by an oil company field unconfirmed party. The seep was said to issue from the bottom of the river and to be most noticeable at low water levels in the fall months prior to freeze-up. The seep apparently is located near outcrops of Paleozoic(?) limestone and dolomite in which bedding dips about 15 degrees south. The seep was described as "a thread of dirty brown bubbles, foam, and froth, and coherent ribbons of brown material streaming downstream from the source area." At least two subsequent oil industry field parties were unable to verify the presence of this seep (Morgridge, 1995a, b).

63 Well with The Louisiana Land and Exploration Co. Doyon Ltd. Well No. 3 was drilled in 1977 no oil or gas to a total depth of 13,533 ft (4,125 m) and abandoned as a dry hole. Numerous occurrences of solid bitumen were reported from Paleozoic limestone and dolomite at 2,690-11,100 ft (820-3,383 m). No shows of oil or gas were reported, but the mudlog shows a possible trace amount of methane at 2,330-2,340 ft (710-713 m) that may be a contaminant or an artifact related to resumption of drilling after casing was set

Well with The Louisiana Land and Exploration Co. Doyon Ltd. Well No. 2 was drilled in 1977 ___ no oil or gas to a total depth 9,123 ft (2,781 m) and abandoned as a dry hole. Occurrences of shows solid bitumen were reported from Paleozoic dolomite at depths of 6,875 ft (2,096 m) and 7,400-7,610 ft (2,256-2,320 m). No shows of oil or gas were reported but trace amounts of methane appear at certain intervals on the mudlog, most notably at depths of 3,280-3,290 ft, 3,500-3,510 ft, 3,780-3790 ft, 4,740-4,770 ft, 5,780-5,880 ft, and 6,530-6,540 ft. The gas at 5,780-5,880 ft was labeled by the mudlogger as "methane possibly from makeup water," suggesting that the methane was a contaminant in water that was used to mix the drilling mud.

Well with The Louisiana Land and Exploration Co. Doyon Ltd. Well No. 1 was drilled in 1976 to no oil or gas a total depth of 11,044 ft (3,366 m) and abandoned as a dry hole. No shows of oil or gas were reported, but "small black particles of dead oil" were encountered at depths of about 1,450 ft (442 m) and a questionable occurrence of solid bitumen was noted at about 10,900 ft (3,322 m). The mudlog shows evidence for trace amounts of methane at numerous intervals within the well, including 1,270-1,280 ft, 1,440-1,460 ft, 2,290-2,300 ft, 4,690-4,720 ft, 4,950-4,960 ft, 7,170-7,180 ft, 7,220-7,230 ft, 9,440-9,450 ft, and 9,900-9,980 ft. The origin of this gas is uncertain. The methane may have been a contaminant in water used for drilling, as suggested for the Doyon No. 2 well; alternatively, the methane may be indigenous to the Mesozoic shale, siltstone, and quartzite that were penetrated by the No. 1 well.

Outcrop of Solid, brittle, vitreous bitumen reportedly occurs as a fracture filling in the Cretaceous oil shale or Keenan Quartzite(?) (Watts, 1992). oil-bearing

Outcrop of "Oil droplets" were reportedly found in a rock sample from the Devonian Nation River

Outcrop of Upper Triassic oil shale is exposed along the Yukon River near the mouth of the oil shale or Nation River (Mertie, 1930, p. 130-131; Mertie, 1937, p. 153-154; Miller and others, ACKNOWLEDGEMENTS oil-bearing 1959, p. 56, 64). Fifteen samples of oil shale from along the west bank of the Yukon River, opposite the mouth of the Nation River, were analyzed and found to contain 1.7 to 12.3 gallons of oil per ton of shale, averaging about 4 gallons per ton (Churkin and Brabb, 1969, p. 9).

Number Feature Description and source(s) of information

156° W

69 Outcrop of Upper Triassic oil shale is exposed along Trout Creek near the Yukon River (Mertic oil shale or 1930, p. 131-132; Miller and others, 1959, p. 56, 64). A distillation test on a sample oil-bearing from this locality indicated about 28 gallons of crude oil per ton of shale (Mertie, 1930, p. 132; Mertie, 1937, p. 263-264). This result led to an estimate of about 2 million barrels of oil-equivalent in near-surface deposits that could be mined, and a further estimate of about 200 billion barrels of oil-equivalent in presumed subsurface extensions of similar-grade deposits (Duncan and Swanson, 1965, p. 14). Subsequent work, however, demonstrated that these estimates were too high; eight gallons of oil per ton of shale and averaged about 4.8 gallons per ton, and geologic

previously believed (Churkin and Brabb, 1969, p. 9). Outcrop of Solid(?) bitumen reportedly fills vugs in stained limestone, and occurs as veins up to oil shale or 3.5 inches (9 cm) long in the Triassic Glenn Shale (unpublished oil industry data). oil-bearing

71 Outcrop of Blebs of bitumen reportedly occur in the Triassic Glenn Shale (Watts, 1992). oil shale or oil-bearing Outcrop of Solid bitumen reportedly occurs in coarse calcite veins and vugs in the Permian oil shale or Tahkandit Limestone (Watts, 1992). oil-bearing

Outcrop of Solid, brittle, vitreous bitumen reportedly occurs as a fracture filling in Precambrian oil shale or rocks (Watts, 1992). Outcrop of Strongly petroliferous limestone with bitumen blebs reportedly occurs in Precambrian

oil shale or rocks and is associated with gas bubbles in a nearby streambed (unpublished oil

oil-bearing industry data). Well with gas Gas was found in unconsolidated Quaternary deposits in a well drilled to total depth show(s) of about 350 ft (107 m) by the Alaska Propane Co., Inc., in the Northway lowlands (Miller and others, 1959, p. 86-87). The gas was found at depths of 195-220 ft (59-67)

Well with gas Gas, presumably trapped beneath permafrost, was found in unconsolidated show(s) Quaternary deposits in a well drilled for water at a spot on the Alaska Highway known as Seaton's Service Station or Seaton's Roadhouse. The gas, mostly methane, was found at a depth of about 200 ft (60 m) and is thought to have been trapped by permafrost (Miller and others, 1959, p. 86-87; Kirschner, 1988).

m), and the bottom of permafrost was found at depths of about 250 ft (76 m).

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